EXCERPTS FROM THE DEPARTMENT RECORD

3. NOISE:

b. Information provided by the Maine CDC/DHHS (Dr. Dora Anne Mills) and DEP noise consultant, EnRAD (Warren L. Brown).

DRAFT **Wind Turbine Neuro-Acoustical Issues**

February 13, 2009

Dora Anne Mills, MD, MPH Maine CDC/DHHS

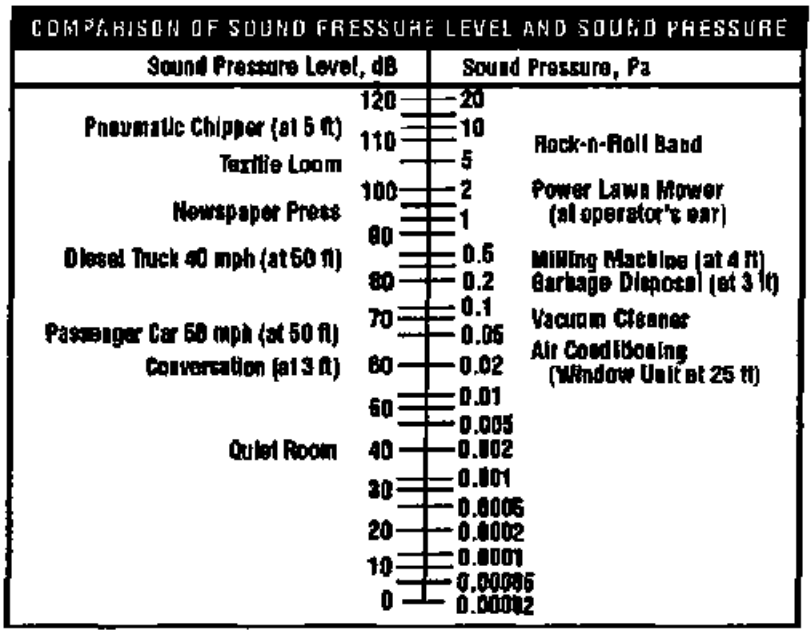
1. What protections are in Maine law regarding excessive noise and vibrations?
Maine DEP has rules that apply to all developments in unorganized areas of the state and in towns without a more restrictive noise ordinance. The rules recognize that excessive noise can degrade health and welfare of nearby neighbors. They limit noise levels for routine operation of a proposed development: to 75 dBA at any time; to 60 dBA during the daytime and 50 dBA during the nighttime for non-commercial and non-industrial areas; and to 55 dBA daytime and 45 dBA nighttime for areas in which ambient sounds are 45 dBA or less daytime or 35 dBA or less nighttime.

In summary: For quiet rural locations, Maine law essentially places a 45 dBA noise limit on most wind turbine projects in Maine. These noise levels are measured at the boundary of the property owned by the proposed developer, which creates a more conservative threshold than measuring directly at a home or other occupied location.

Sources:

- Maine DEP rule-making authority on noise is in Title 38 Section 343
  Rules are in Chapter 375, Section 10:
  http://www.maine.gov/sos/cec/rules/06/096/096c375.doc
- Maine SPO Noise Technical Assistance Bulletin
  http://www.maine.gov/spo/landuse/docs/techassist/techassistbulletins/noisetabulletin.pdf

2. What do different noise levels compare to?
40 dBA is comparable to a quiet room. 55 dBA is comparable to a household room or office in which there is normal background vibration and sounds such as is commonly found from household appliances. Many rural locations where wind turbine facilities are located or proposed to be located can routinely have ambient noise levels in excess of 50 dBA as a result of wind generated noise.



Canadian Centre for Occupational Health and Safety
(see www.ccohs.ca/oshanswers/phys_agents/noise_basic.html).

3. What kinds of noises are expected from wind turbines?

According to several resources, new wind turbines are relatively quiet, and meet federal and international standards and regulations for noise, including Maine's regulations. They do however generate noise that can be measured and assessed for compliance with the state's regulations.

According to the US Department of Energy, a modern wind farm at a distance of 750 – 1,000' is no louder than a kitchen refrigerator or a moderately quiet room.

In terms of residential wind turbines, another Department of Energy source states, "The sound level of most modern residential wind turbines is slightly above the ambient wind noise. This means that while the sound of the wind turbine may be picked out of surrounding noise if a conscious effort is made to hear it, a residential-sized wind turbine *is not a significant source of noise under most wind conditions.*"

Sources:

- US Dept of Energy's Wind Energy Guide for County Commissioners:
  http://www.nrel.gov/wind/pdfs/40403.pdf
  Page 6: An operating modern wind farm at a distance of 750'-1,000' is no louder than a kitchen refrigerator or moderately quiet room.
- University of Massachusetts Renewable Research Energy Laboratory:
  http://www.windpoweringamerica.gov/pdfs/workshops/mwwg_turbine_noise.pdf
  Contains a number of resources on sounds emitted from wind turbines
- Noise levels of small residential wind turbines:

Dept of Energy's Consumer Guide on Small Wind Turbines
http://apps1.eere.energy.gov/consumer/your_home/electricity/index.cfm/mytopic=10930
Comparable sounds to wind turbines

- Wind Turbine Noise Issues: A white paper prepared by Renewable Energy Research Laboratory, U of Massachusetts, 2004:
http://www.town.manchester.vt.us/windforum/aesthetics/WindTurbineNoiseIssues.pdf

4. Are there health effects to the levels of sound heard by wind turbines?
According to a 2003 Swedish EPA review of noise and wind turbines:
"Interference with communication and noise-induced hearing loss is not an issue when studying effects of noise from wind turbines as the exposure levels are too low."

In my review I found no evidence in peer-reviewed medical and public health literature of adverse health effects from the kinds of noise and vibrations heard by wind turbines other than occasional reports of annoyances.

Most studies on health effects of noise have been done using thresholds of 70 dBA or higher outdoors, much higher than what is seen in wind turbines.

Sleep disturbance is another concern, and the WHO guidelines for community noise recommend that outdoor noise levels in living areas for nighttime not exceed 45 dBA, which is consistent with Maine law.

Sources:

- Noise Annoyance from Wind Turbines – A Review 2003 Sweden Environmental Protection Agency
http://www.barrhill.org.uk/windfarm/noise/10%20pederson.pdf
This study found no evidence of health problems, reviews the variety of noise regulation laws in place in Europe
- British Medical Journal 2007 Swedish Study (Eja Pedersen)
http://oem.bmj.com/cgi/content/full/64/7/480?ijkey=b1a1ae4a98c9453315a90941395e0a05262aca53
Survey in Sweden of residents near wind turbines found annoyance increased with increased sound pressure levels (SPLs), and increased annoyance was associated with lower sleep quality and negative emotions.
- *Noise Pollution: Non-Auditory Effects on Health*, 2003
http://bmb.oxfordjournals.org/cgi/content/full/68/1/243
- World Health Organization Community and Occupational Noise
http://www.who.int/mediacentre/factsheets/fs258/en/
- World Health Organization 2002 Technical Meeting on Relationship Between Noise and Health
http://www.euro.who.int/document/NOH/exposerespnoise.pdf

Page 52 says that WHO standard is for nighttime noise not to exceed 45 dB.

5. What about low frequency noises?

Some have pointed to low frequency vibrations emitted from wind turbines as a possible source of adverse health effects. One recent study commonly cited is: "Tuning and sensitivity of the human vestibular system to low-frequency vibration", Todd, et al. Neuroscience Letters, 2008, which can be found at: http://www.ncbi.nlm.nih.gov/pubmed/18706484.

This study indicates that the human vestibular system is sensitive, which means it shows a physiological response, to low-frequency and infrasound vibrations of -70 dB, indicating that human seismic receptor sensitivity of the vestibular system may possibly be on par with the frog ear. However, sensitivity, i.e. showing a physiological response, *does not mean there are adverse effects.*

Low frequency and infrasound (lower than what is perceptible) vibrations are very commonly in our background, and known to be emitted from many household appliances and vehicles. Exposure to very intense low frequency noise can be annoying and may adversely affect overall health, though these levels appear to be more intense than what is measured from modern wind turbines.

Maine noise regulations assess the distribution of noise generated by a regulated project based on its frequency and can regulate noises with a specific tonal contribution that outweighs the other frequency components of the generated noise.

Sources:

- Characteristics of low frequency signals emitted from home electric appliances: http://sciencelinks.jp/j-east/article/200507/000020050705A0229983.php,
- Magnetic Emission Ranking of Electrical Appliances: http://rpd.oxfordjournals.org/cgi/content/abstract/ncm460v1)
- Sources and Effects of Low-Frequency Noise 1996 http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=JASMAN000099000005002985000001&idtype=cvips&gifs=yes
  J. Acoust. Soc. Am. Volume 99, Issue 5, pp. 2985-3002 (May 1996)

6. What are the health benefits to wind turbines?

- Wind turbines mean less dependency on foreign oil and coal that contribute to global warming and pollution (coal produces carbon dioxide, acid rain, smog, particulate pollution, carbon monoxide, and mercury). Maine's highest in the nation rates of asthma and high rates of cancer can be positively impacted by less dependency on these sources.

- According to the Natural Resources Council of Maine: *"If Maine generated five percent of its electricity from wind power by 2010, as called for by the Council,*

there would be significant pollution cuts: 480,000 tons of carbon dioxide; 1,680 tons of sulfur dioxide; and 1,152 tons of nitrogen oxides annually. 'We believe the development of wind power, properly located, should be a centerpiece of Maine's policies to generate clean power, reduce air pollution and halt climate change,' said Peter Didisheim."

7.What about a moratorium on wind turbine projects?

I do not find evidence to support a moratorium on wind turbine projects at this time.

Basic Wind Turbine Noise-Related Resources:

- US Dept of Energy's New England Wind Power Website on Wind Turbine Sound – this has a good summary and links to references
  http://www.windpoweringamerica.gov/ne_issues_sound.asp
- Canada Center for Occupational Health and Safety, Noise: Basic Information
  http://www.ccohs.ca/oshanswers/phys_agents/noise_basic.html
- Massachusetts DEP Regulations
  http://www.nonoise.org/lawlib/states/mass/mass.htm
  A source of sound will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:
  Increases the broadband sound level by more than 10 dB(A) above ambient, or
  Produces a "pure tone" condition - when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.
  These criteria are measured both at the property line and at the nearest inhabited residence. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during equipment operating hours. The ambient may also be established by other means with the consent of the Department.
- Ongoing Research is being done by the US Dept of Energy Wind Turbine Aeroacoustic Research:
  http://www1.eere.energy.gov/windandhydro/wind_research_enable.html#research
  "Turbine noise can be caused by rotor speed, blade shape, tower shadow, and other factors. The program is sponsoring both wind tunnel and field tests to develop a noise prediction code that turbine manufacturers can use to ensure that new rotor designs and full systems aren't too noisy. This is especially true for high-growth U.S. markets for small wind turbines that will demand quieter rotors, especially when turbines are sited in residential neighborhoods. Small turbines operate at high rotational speeds and tend to spin even if they are furled (pointed out of the wind).

Re Wind Turbine Sound Assessment Update -- Rollins Project Revised Statement.txt
From: Warren Brown [Warren_Brown@umit.maine.edu]
Sent: Friday, March 27, 2009 7:37 AM
To: Maddox, Becky
Subject: Re: Wind Turbine Sound Assessment Update -- Rollins Project Revised Statement

Hi Becky,

It's my opinion the Rollins Wind Project noise assessment is essentially reasonable and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10) with a possible omission involving excessive amplitude modulation and the resulting penalty for short duration repetitive sound.

The wind project prediction model based on CADNA/A software with incorporation of an uncertainty factor of + 5 dBA and intentional omission of possible attenuating factors yields an estimate that does not account for potential excessive amplitude modulation under stable atmospheric conditions, which would invoke a 5 dB penalty for short duration repetitive sounds, potentially resulting in borderline protected locations (greater than or equal to 43 dBA) receiving greater than predicted sound levels, even potentially in excess of 45 dBA. The 2 possible locations are measurement locations R2 and R3 along RT 6.

Infrasound, sonic frequencies <20 Hz, have been widely accepted to be of no concern below the common human perception threshold of 85-90 dBG for non-pure tone sounds. There is insufficient, broadly accepted evidence to conclude otherwise. Numerous national infrasound standards limit industrial facilities, impact equipment and jet engines, but wind turbine infrasound levels fall far below these standards.

Wind turbines, rotating, under conditions necessary for power production produce a measurable broadband (lower frequencies) amplitude modulation of sound ("swoosh" and/or "thump") at ±1 Hz, which should not be confused with infrasound.
The A-weighting scale is widely used in noise ordinances, equipment specification and sound control regulation. The introduction of C-weighting for the assessment of wind turbine sound is preliminary and unrefined on a broad basis. Current international wind turbine acoustic output standards do not require dBC or dBG rating.

I recommend a required routine operation noise compliance assessment methodology for wind turbine projects based on very selective meteorological, background sound conditions and careful specified sound measurement parameters which will require compliance measurements under most favorable conditions for sound propagation, during periods of significant maximum amplitude modulation and appropriate measurement parameters. I will submit these recommendations and the peer review under separate covers.

Warren

"Maddox, Becky" <Becky.Maddox@Maine.gov> writes:
>Hi Warren,
>Thanks for the update. As you are aware, there are 2 separate items
>that we need comments on from you, one being comments regarding the
>application and the other being the response to the public comments.
>
>Please provide your comments to myself and Jim regarding your concerns
>with the study that was submitted by RSE on the Rollins Wind project
>and the fact that this study does not adequately address low frequency
>noise. Also, please explain that this issue can be addressed through a
>different model (please provide the details) and that you are
>recommending a protocol, and explain why we need this protocol. (We do
>not need the details of the protocol at this point).
>

>Please submit your comments to us by the end of the day today, as this
>information needs to be placed in the draft order, which we are trying
>to have finished by tomorrow.
>
>Regarding the public questions/comments, please do not feel like you
>have to address each one individually. The general concern of the
>public seems to be the fact that we are not using dBC, so please
>discuss this issue explain why it is not necessary to use dBc and why
>what it being proposed will be sufficient to address low frequency
>sound and infrasound.
>
>Please note that this information does need to be submitted soon,
>however, the information regarding your comments is much more crucial
>at this point.
>
>Thanks and please let me know if you have any questions.
>
>Becky
>
>
>
>-----Original Message-----
>From: Warren Brown [mailto:Warren_Brown@umit.maine.edu]
>Sent: Wednesday, March 25, 2009 10:14 AM
>To: Cassida, James
>Cc: Maddox, Becky
>Subject: Wind Turbine Sound Assessment Update
>
>Jim,
>
>RSE (Scott and Charlie) called to discuss the sound assessment
>recommendations (submitted to you on March 20) in detail yesterday
>morning (3 hrs). We substantially ended up on the same page, but their
>recommendation to the state will be proceeding with application
>approval compliance measurement techniques completed following the
>permit approval. They mentioned that a number of other areas in the
>permit application are handled that way, but I am unfamiliar with this
>process. RSE is very certain that the model predictions made for both
>projects will result in Project compliance, and I remain cautiously
>reserved.
>
>The morning's conversation seemed helpful and should result in an
>improved compliance testing methodology, which will be far more
>defensible.
>
>Re: my acceptance of their proposed "compliance testing details-- later"
>is unfamiliar to me, and seemingly inflammatory to public stakeholders,
>please be certain to delineate usual practices, if this is in fact a
>direction that you would choose to go in. I do not want to place
>myself "between a rock and a hard place"
>as a result of a blind spot.
>
>I have briefly reviewed the 10 p.m. submission that Charlie made me
>3/24/09, and take exception with a few of the assumptions (liberties)
>that he carried forward from our conversation. I cannot dedicate today
>(8-5 p.m.)to clarifying these issues.
>
>I was ill for the first two days of this week, and am buried under a
>backlog from all directions. I understand there is vigorous haste on
>the part of the applicants, but I cannot accommodate that today. I
>will respond to Charlie's remarks this evening.
>
>Warren

>
>**********
>*
>**********
>Warren L. Brown
>Radiation Safety Officer
>University of Maine
>5784 York Village Building 7
>Orono, Maine 04469
>
>
>Phone: (207) 581-4057
>Fax: (207) 581-4085
>E-mail: warren.brown@maine.edu
>
>

****
****
Warren L. Brown
Radiation Safety Officer
University of Maine
5784 York Village Building 7
Orono, Maine 04469

Phone: (207) 581-4057
Fax: (207) 581-4085
E-mail: warren.brown@maine.edu

Rollins Wind Project Sound Level Assessment -- Peer Review

LINCOLN, MAINE

Warren L. Brown

April 6, 2009

Submitted by:

EnRad Consulting
516 Main Street
Old Town, Maine 04468

Submitted to:

Becky Maddox
Maine Department of Environmental Protection
Augusta ME 04433

Rollins Wind Project Sound Level Assessment
Peer Review

Contents

Review Basis

Evergreen Wind Power III, LLC proposes to operate a 60 MW wind energy facility on North and South Rollins Mountains in Penobscot County, Maine. At the request of the Maine Department of Environmental Protection (MDEP) a peer review is undertaken to determine if the noise study is reasonable and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10).

The proposed wind farm noise assessment report will be generally critiqued unless detailed criticism is given.

1.0 Introduction

The stated objective of the sound assessment was to determine the expected sound levels from routine operation of the wind project and compare them with the relevant environmental noise standards. Sound levels from the construction activity, and operation of the substation and other electrical transmission facilities are briefly discussed

The routine operation sound level estimates are compared to the Maine DEP sound level limits to demonstrate that Rollins Wind Project will meet applicable sound level limits.

2.0 Sound and Decibels

Informational

3.0 Site Description

The wind turbine portion of the project consists of 40 General Electric 1.5 MW turbines located a top Rollins North and South in the Lincoln, Lee, Winn and Burlington (Penobscot County). Operation of the substation and transmission line is not expected to generate significant sound levels. Sound level estimates for the wind project to not include these facilities.

The turbines will generally run North-South along various ridges with base elevations of the turbines ranging from approximately 700 -- 1260 feet above sea level. In addition to the turbine structures, the project will include construction of an operations and maintenance facility at the south end and the substation near the north end of Rollins North.

The report indicates nearest protected locations lie between Rollins North and South within the towns of Lincoln and Lee. Numerous seasonal residences surround this project site, which is largely undeveloped forestry land.

Evergreen Wind Power III (Evergreen III) has purchased property or obtained leases with local landowners to install and operate wind turbines at the proposed locations. Evergreen III has also obtained agreements with landowners who may experience sound levels from the project that have the potential to exceed applicable sound level limits (MDEP Chap 375.10)

Parcels for which Evergreen III has a lease, easement or other arrangement are indicated in the assessment.

4.0. Noise Control Standards

Land-use ordinances for Burlington, Lee, Lincoln and Winn indicate that no quantitative noise standards are enacted in these municipalities, consequently Maine DEP Chap 375.10 regulations apply.

5.0 Existing Sound Levels

Evergreen III proposes to not confirm predevelopment ambient sound levels, but rather, in recognition of the rural nature of the site accept the most conservative regulation levels of 55 dBA daytime and 45 dBA nighttime. Mention is made of elevated wind effects on ambient noise during wind speeds required for turbine operation.

6.0 Sound Level Limits

Sound level limits were determined at protected locations and property lines based on land owner agreements and land uses. As previously mentioned, Evergreen has obtained leases or agreements with many local landowners to exempt the project from sound level limits at those sites.

Five nearby sensitive receiver points (protected locations) are listed with proposed measurement locations respective to residences/property boundaries and estimated development impact.

7.0 Future Sound Levels

7.1 Construction

Standard discussion

7.2 Proposed Operation

Operation sound level estimates were based on an acoustic model employing CADNA/A software utilizing area topography and wind turbine locations as provided by Stantec.

Wind turbine operation and sound power output relative to wind speed are discussed and plotted. Sound level estimates are based on full turbine sound power output plus and an uncertainty factor of ± 5 dBA to allow for wind turbine sound power specification (IEC 61400-11) and outdoor propagation prediction (ISO 9613-2) uncertainties Attenuation factors were intentionally omitted from the estimate model, which may have lessened resulting estimates further.

Selected sensitive receiver position sound level estimates from routine wind turbine operation range from 39-45 dBA. Actual measured sound levels will vary substantially with wind speeds/directions, subsequent to microphone interference and numerous wind generated noise sources (ambient + operation).

Wind speed generally varies with the elevation and may contain both horizontal and vertical components. Sound level measurements taken during turbine operation levels at or near maximum power will occur under a wide range and type of increased wind speeds. These measurement periods will be characterized by times when wind turbines are completely inaudible due to high ambient noise and other times when surface level operation noise is more prominent.

Accurate, measurement-derived operation sound levels can only be made when conditions permit, a clear separation between operation and background noise. Forested receiver locations may not allow separation of operation and ambient noise sources under windy conditions.

Tonal and short duration repetitive sounds are not expected based on manufacturer specifications and prior experience, but short duration repetitive sounds may occur as a result of amplitude modulation during some conditions -- to be specified in recommendations.

8.0 Conclusions and Recommendations

Maine DEP sound level limits based on land use and land owner agreements were conservatively set at "quiet limits -- 45 dBA nighttime./55 dBA daytime" (within 500 feet of residence).

The proposed sensitive receiver sites, R-1 through R-5, are appropriate in number and general location to assess wind turbine operation compliance for nearby protected locations. Operations of the substation and transmission lines generally do not generate significant sound levels.

The wind project prediction model based on CADNA/A software with incorporation of an uncertainty factor of ± 5 dBA and intentional omission of possible attenuating factors may yield a reasonable if not conservative estimate, if short duration repetitive sounds are not problematic.

I will further recommend specifications for RSE's recommendations to measure predevelopment ambient sound levels at respective protected locations under conditions representative of operations with subsequent project operation compliance testing.

Conclusion - (Peer Review)

It's my opinion the Rollins Wind Project noise assessment is essentially reasonable and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10) with a possible omission involving excessive amplitude modulation and the resulting penalty for short duration repetitive sound.

The wind project prediction model based on CADNA/A software with incorporation of an uncertainty factor of + 5 dBA and intentional omission of possible attenuating factors yields an estimate that does not account for potential excessive amplitude modulation under stable atmospheric conditions, which would invoke a 5 dB penalty for short duration repetitive sounds, potentially resulting in borderline protected locations (greater than or equal to 43 dBA) receiving greater than predicted sound levels, even potentially in excess of 45 dBA. The 2 possible locations are measurement locations R2 and R3 along RT 6.

Infrasound, sonic frequencies <20 Hz, have been widely accepted to be of no concern below the common human perception threshold of 85-90 dBG for non-pure tone sounds. There is insufficient, broadly accepted evidence to conclude otherwise. Numerous national infrasound standards limit industrial facilities, impact equipment and jet engines, but wind turbine infrasound levels fall far below these standards.

Wind turbines, rotating, under conditions necessary for power production produce a measurable broadband (lower frequencies) amplitude modulation of sound ("swoosh" and/or "thump") at ±1 Hz, which should not be confused with infrasound.

The A-weighting scale is widely used in noise ordinances, equipment specification and sound control regulation. The introduction of C-weighting for the assessment of wind turbine sound is preliminary and unrefined on a broad basis. Current international wind turbine acoustic output standards do not require dBC or dBG rating.

I recommend a required routine operation noise compliance assessment methodology for wind turbine projects based on very selective meteorological, background sound conditions and careful specified sound measurement parameters which will require compliance measurements under most favorable conditions for sound propagation, during periods of significant maximum amplitude modulation and appropriate measurement parameters.

Compliance sound assessment of wind turbines require carefully specified measurement conditions, monitoring specifications and reporting requirements. Compliance should be demonstrated, based on following outlined conditions for 12, 10-minute measurement intervals per monitoring location meeting 06-096 CMR 375.10 requirements.

Extraneous sounds could potentially or do complicate routine operation compliance assessment. If the applicant must adjust for such sounds, background ambient monitoring will be necessary. If background ambient monitoring is proposed, locations and times should be determined with concurrence from the MDEP.

a. Compliance will be demonstrated when the required operating/test conditions have been met for twelve 10-minute measurement intervals at each monitoring location.

b. Measurements will be obtained during weather conditions when wind turbine sound is most clearly noticeable, i.e. when the measurement location is downwind of the development and maximum surface wind speeds ≤6 mph with concurrent turbine hub-elevation wind speeds sufficient to generate the maximum continuous rated sound power from the five nearest wind turbines to the measurement location. [Note: These conditions occur during inversion periods usually between 11pm-5am.] Measurement intervals affected by increased biological activities, leaf rustling, traffic, high water flow or other extraneous ambient noise sources that affect the ability to demonstrate compliance will be excluded from reported data. The intent is to obtain 10-minute measurement intervals that entirely meet the specified criteria. A downwind location is defined as within 45° of the direction between a specific measurement location and the acoustic center of the five nearest wind turbines.

c. Sensitive receiver sound monitoring locations should be positioned to most closely reflect the representative protected locations for purposes of demonstrating compliance with applicable sound level limits, subject to permission from the respective property owner(s). Selection of monitoring locations should require concurrence from MDEP.

d. Meteorological measurements of wind speed and direction should be collected using anemometers at a 10-meter height above ground at the center of large unobstructed areas and generally correlated with sound level measurement locations. Results should be reported, based on 1-second integration intervals, and be reported synchronously with hub level and sound level measurements at 10 minute intervals. The wind speed average and maximum should be reported from surface stations. MDEP concurrence on meteorological site selection is required.

e. Sound level parameters reported for each 10-minute measurement period, should include A-weighted equivalent sound level, 10/90% exceedance levels and ten 1-minute 1/3 octave band linear equivalent sound levels (dB). Short duration repetitive events should be characterized by event duration and amplitude. Event frequency is defined as the average event frequency +/- 1SD and amplitude is defined as the peak event amplitude minus the average minima sound levels immediately before and after the event, as measured at an interval of 50 ms or less, A-weighted and fast time response, i.e. 125 ms. For each 10-minute measurement period short duration repetitive sound events should be reported by percentage of 50 ms or less intervals for each observed amplitude integer above 4 dBA. Reported

f. Compliance locations should be determined in consultation with the Department.

Compliance data collected in accordance with the assessment methods outlined above for representative locations selected in accordance with this protocol should be submitted to the Department for review and approval prior to the end of the first year of facility operation. Compliance data for each location should be gathered and submitted to the Department at the earliest possible opportunity after the commencement of operation, with consideration for the required weather, operations, and seasonal constraints.

Rollins Wind Project
Wind Turbine Sound Compliance Assessment Plan

Submitted by
Evergreen Wind Power III, LLC

Final Revised April 6, 2009

This wind turbine sound compliance assessment plan was developed jointly by Evergreen and Maine DEP with the advice and guidance of their respective acoustical consultants. Recommendations for testing protocols were drafted by EnRad Consulting of Old Town, Maine on behalf of Maine DEP, and further refined in consultation with Evergreen and Resource Systems Engineering (RSE) of Brunswick, Maine.

The sound compliance assessment for the Rollins Wind Project requires carefully specified measurement conditions, monitoring specifications and reporting requirements to characterize and consistently quantify wind turbine sound levels. RSE has developed this compliance assessment plan in consultation with the Department and development compliance for the project will be demonstrated when the following outlined conditions have been met for 12, 10-minute measurement intervals per monitoring location meeting 06-096 CMR 375.10 requirements.

Extraneous sounds could potentially or do complicate routine operation compliance assessment. If the applicant must adjust for such sounds, background ambient monitoring will be necessary. If background ambient monitoring is proposed, locations and times will be determined with concurrence from the MEDEP.

a. Compliance will be demonstrated when the required operating/test conditions have been met for twelve 10-minute measurement intervals at each monitoring location.

b. Measurements will be obtained during weather conditions when wind turbine sound is most clearly noticeable, i.e. when the measurement location is downwind of the development and maximum surface wind speeds ≤6 mph with concurrent turbine hub-elevation wind speeds sufficient to generate the maximum continuous rated sound power from the five nearest wind turbines to the measurement location. [Note: These conditions occur during inversion periods usually between 11pm-5am.] Measurement intervals affected by increased biological activities, leaf rustling, traffic, high water flow or other extraneous ambient noise sources that affect the ability to demonstrate compliance will be excluded from reported data. The intent is to obtain 10-minute measurement intervals that entirely meet the specified criteria. A downwind location is defined as within 45° of the direction between a specific measurement location and the acoustic center of the five nearest wind turbines.

c. Sensitive receiver sound monitoring locations will be positioned to most closely reflect the representative protected locations for purposes of demonstrating compliance with applicable sound

level limits, subject to permission from the respective property owner(s). Selection of monitoring locations will require concurrence from Maine DEP.

d. Meteorological measurements of wind speed and direction will be collected using anemometers at a 10-meter height above ground at the center of large unobstructed areas and generally correlated with sound level measurement locations. Results will be reported, based on 1-second integration intervals, and be reported synchronously with hub level and sound level measurements at 10 minute intervals. The wind speed average and maximum will be reported from surface stations. Maine DEP concurrence on meteorological site selection is required.

e. Sound level parameters reported for each 10-minute measurement period will include A-weighted equivalent sound level, 10/90% exceedance levels and ten 1-minute 1/3 octave band linear equivalent sound levels (dB). Short duration repetitive events will be characterized by event duration and amplitude. Event frequency is defined as the average event frequency +/- 1SD and amplitude is defined as the peak event amplitude minus the average minima sound levels immediately before and after the event, as measured at an interval of 50 ms or less, A-weighted and fast time response, i.e. 125 ms. For each 10-minute measurement period short duration repetitive sound events will be reported by percentage of 50 ms or less intervals for each observed amplitude integer above 4 dBA. Reported measurement results will be confirmed to be free of extraneous noise in the respective measurement intervals to the extent possible and in accordance with (b.).

f. Compliance locations will be determined in consultation with the Department.

g. Compliance data collected in accordance with the assessment methods outlined above for representative locations selected in accordance with this protocol will be submitted to the Department for review and approval prior to the end of the first year of facility operation. Compliance data for each location will be gathered and submitted to the Department at the earliest possible opportunity after the commencement of operation, with consideration for the required weather, operations, and seasonal constraints.